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| 09/821,787 | 03/29/2001 | Juergen Weichart | 622/49809 | 8526 |

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| EXAMINER |
|---|
| MCDONALD, RODNEY GLENN |

| ART UNIT | PAPER NUMBER |
|---|---|
| 1753 | |

DATE MAILED: 09/17/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

| Application No. | Applicant(s) |
|---|---|
| 09/821,787 | Weichart |
| **Examiner** | **Art Unit** |
| Rodney McDonald | 1753 |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1) ☒ Responsive to communication(s) filed on *Jul 3, 2002* .

2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

**Disposition of Claims**

4) ☒ Claim(s) *2-5 and 13-29* is/are pending in the application.

4a) Of the above, claim(s) _____ is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) *2-5 and 13-29* is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claims _____ are subject to restriction and/or election requirement.

**Application Papers**

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are a) ☐ accepted or b) ☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13) ☒ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) ☒ All b) ☐ Some* c) ☐ None of:

1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

a) ☐ The translation of the foreign language provisional application has been received.

15) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____
4) ☐ Interview Summary (PTO-413) Paper No(s). _____
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

## DETAILED ACTION

### *Claim Rejections - 35 USC § 112*

1. Claims 17 and 22 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 17 is indefinite because "said plasma density measuring apparatus" lacks antecedent basis.

Claim 22 is indefinite because it is unclear because it is unclear what "exchanging" and "having been loaded" indicates.

### *Claim Rejections - 35 USC § 103*

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 2-5, 13, 14 and 19-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lai et al. (EP 0 801 413) in view of Donohoe (U.S. Pat. 5,449,433).

Lai et al. teach in Figure 5 an elevational cross section of an ICP reactor according to a presently preferred embodiment of the present invention. Besides implementing the double vertically slotted shield as discussed above, there are also several other innovative features in this design. An upper and lower adapter end flange are used to provide vacuum seals between the

dielectric cylinder 24 and other portions of the reactor chamber. It is presently preferred to fabricate the adapters of aluminum. In Fig. 5 lower aluminum adapter flange 34 is shown sealing dielectric cylinder 24 to reactor chamber flange 36. Similarly the magnetron target assembly 38 forms a cover of the reactor chamber and includes magnetron target 40 and a ceramic insulator 42 to which upper aluminum adapter flange 32 seals dielectric cylinder 24. (Column 8 lines 12-27)

Aluminum adapter flanges 32, 34 also serve as electrical conductors to ground the shields 28, 30 to the chamber wall and may be used to aid in supporting the weight of the upper portion of the chamber assembly including the magnetron target assembly 38, if desired. The spacing between the two aluminum adapter flanges 32, 34 is determined by: (1) the outer ground shield 44 (which serves as the return RF current path of the shields 28, 30 and as a radiation shield for the RF coils 26 for purposes of reducing RF interference emitted to the environment); (2) by insulating standoffs between them; or (3) by the height of the dielectric cylinder 24. (Column 8 lines 28-39)

The Faraday-sputter shield structure 28, 30 essentially eliminate capacitive coupling between the RF coil and the plasma by providing an electrical short that prevents the capacitive component of the field caused by the RF coil from propagating to the inside of the Faraday-sputter shield. (Column 8 lines 54-59)

In order to form a plasma a radio frequency power source is generally used to provide power to one or more powered electrodes within a vacuum vessel containing a gas at a predetermined pressure in which the processing is to take place. (Column 1 lines 16-24)

Figure 1 shows biasing the substrate support with RF or DC power supply. (See Figure 1)

Figs. 2A-2E show shield configurations. (See Figs. 2A-2E)

The differences between Lai et al. and the present claims is that the distribution of the slits in the Faraday shield is not discussed.

Donohoe teach in Fig. 3 a reactor of the present invention having the electrostatic shield in place. Fig.3 is the same as Fig. 2 with the exception of the electrostatic shield 17. The reactor has two loop antennas 11. The bell jar 10A is typically comprised of alumina or quartz or a similar dielectric which is removed relatively easily by the ion bombardment. The electrostatic shield 17 significantly decreases the capacitive coupling between the antenna 11 in the Mori source reactor (or the coils in another type of inductively coupled source) and the plasma. The capacitive coupling is decreased because the shield 17 protects or blocks the plasma from the antenna's electric field. The electric field is responsible for the capacitive coupling. (Column 3 lines 8-17; Column 4 lines 11-18; Figs. 2 and 3)

The shield in the preferred embodiment is cylindrical in shape and fits over the bell jar 10A portion of the reactor 10. However, it is possible to use a shield 17 having a hemispherical shape (not shown), or alternatively, having a combination cylindrical/hemispherical shape (not shown). The shield 17 is disposed between the bell jar 10A and the antennae 11, where it functions to substantially prevent capacitive coupling between the antennae 11 and the plasma. (Column 4 lines 40-48)

Bands or strips of metal 17C are located between the slits 17A. The bands 17C have a width which is preferably larger than the width of the intervening slits 17A. The width of the bands or strips 17C will vary, depending upon the reactor parameters chosen. However, generally the width in the relative range of 1 cm is used for the metal bands 17C. The width of the intervening slits 17A tends to be a little smaller, and is generally in the range of 0.2 cm to 0.5 cm. (Column 4 lines 49-57)

The electrostatic shield 17 is comprised of a conductive material, preferably copper. Copper is preferred due to its cost and availability, and the ease with which it can be cut. (Column 4 lines 58-61)

The motivation utilizing a distribution of slits is that it allows for prevention of capacitive coupling. (Column 2 lines 1-13)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Lai et al. by utilizing a distribution of slits as taught by Donohoe because it allows for preventing capacitive coupling.

4. Claims 15 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lai et al. in view of Donohoe as applied to claims 2-5, 13, 14 and 19-27 above, and further in view of Forster et al. (EP 0 782 172).

The differences not yet discussed is applying power to the sputter target.

Forster et al. teach in Figure 1 applying a DC voltage to the sputter target. (See Figure 1)

The motivation for applying DC voltage to the sputter target is that it allows for depositing material onto a semiconductor wafer. (Column 1 lines 3-9)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have applied a DC power to the sputter target as taught by Forster et al. because it allows for depositing material onto a semiconductor wafer.

5. Claims 16-18 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lai et al. in view of Donohoe as applied to claims 2-5, 13, 14 and 19-27 above, and further in view of Nihei et al. (U.S. Pat. 4,999,096).

The differences not yet discussed is the controlling circuitry.

Nihei et al. teach in FIGS. 1 to 3, an embodiment of a thin film forming apparatus according to the present invention will be described. FIG. 3 diagrammatically shows waveforms used in the apparatus. In FIG. 3, PW denotes a sputter peak power (voltage), BW a sputter base power (voltage), PV a bias peak voltage, BV a bias base voltage, BW/PW a sputter base power ratio, T2/(T1+T2) a bias ratio, and (T1+T2) a switching period. Referring to FIG. 1, the thin film forming apparatus comprises a waveform-controlled sputter power source 2, a constant-voltage waveform-controlled reverse sputter power source 1, a bias current detecting sensor 4, a high frequency coil 5 for generating plasma, a bias current controlling high frequency power source 3 for controlling a bias current and enabling a stable discharge at a high vacuum region, a vacuum chamber 17 within which film is formed, a substrate (e.g., Si substrate) 8, a target 6, insulators 10, and an optional waveform generator 9 made of a CPU and the like for setting sputter power,

bias voltage and current waveforms under program control. (Column 4 lines 55-68; Column 5 lines 1-9)

With the thin film forming apparatus constructed as above, first the optional waveform generator 9 sets the sputter power waveform, bias (reverse sputter) waveform and bias current. These signals set by the optional waveform generator 9 are supplied to the waveform controlled sputter power source 2, constant-voltage waveform controlled reverse sputter power source 1 and bias current controlling high frequency power source 3. These power sources have feedback functions to maintain the waveforms as set, even under variation of loads or the like. Therefore, a change in any one set value will not affect the other values. A bias current control method which is one of the features of this invention will be described in detail. A bias current with the bias voltage PV set, e.g., at 150 V changes if for example a sputter power is changed. To avoid this, a bias current is detected by the bias current detecting sensor 4 and compared with a signal set by the optional waveform generator 9. Based on this comparison, the bias current is maintained at the set value by controlling a high frequency power supplied to the high frequency coil 5 by means of the bias current controlling high frequency power source 3. These operations serve to maintain stable discharge at a high vacuum region. (Column 5 lines 10-33)

Sine Nihei et al. teach control means for sensing the current which is made up of power and voltage it is believed to meet the voltage sensing limitation. (See Nihei et al. discussed above)

The motivation for utilizing control circuitry is that it allows for maintaining stable discharge. (Column 5 lines 32-33)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized controlling circuitry as taught by Nihei et al. because it allows for maintaining stable discharge.

***Response to Arguments***

6. Applicant's arguments filed September 16, 2002 have been fully considered but they are not persuasive.

***RESPONSE TO ARGUMENTS:***

In response to the argument that Donohoe does not suggest protecting the interior wall of the chamber, it is argued that Lai et al. teach providing a shield to protect the interior wall of a chamber and the Donohoe suggest the spacing for a Faraday shield. (See Lai et al. and Donohoe discussed above)

In response to the argument that Nihei et al. is irrelevant to the present invention, it is argued that Nihei et al. is relevant since Nihei et al. suggest controlling the power to control to control the density of the plasma. (See Nihei et al. discussed above)

***Conclusion***

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after

the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rodney McDonald whose telephone number is 703-308-3807. The examiner can normally be reached on M-F from 8 to 5:30. The examiner can also be reached on alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam X. Nguyen, can be reached on (703) 308-3322. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9310.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

RODNEY G. MCDONALD
PRIMARY EXAMINER

RM

September 16, 2002